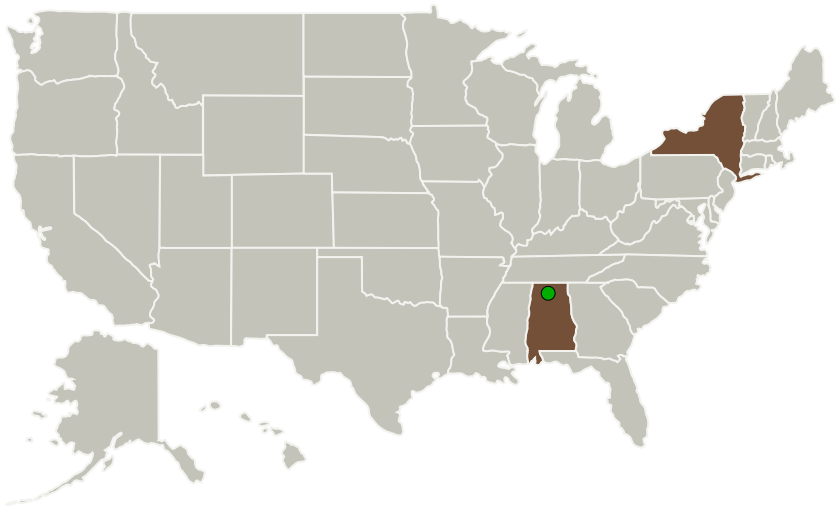
Light Weight, Scalable Manufacturing of Telescope Optics, Phase I

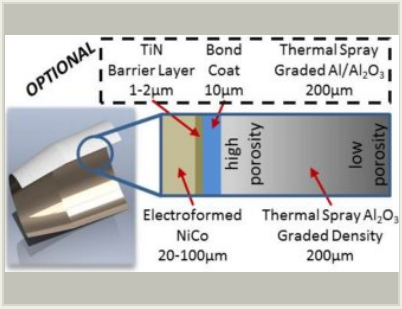
Completed Technology Project (2013 - 2013)

Project Introduction

NASA's future X-ray astronomy missions will require X-ray optics that have large effective areas, are lightweight, and cost effective. Recent X-ray telescopes, such as the Chandra Observatory, utilized reflectors made from zerodur which were up to 20mm thick. The thickness of the reflector as well as the mass limited the number of nested optics that could be implemented. The current state of the art reflectors are made from electroformed nickel/cobalt which is on the order of 1mm thick. The implementation of these thin optics have greatly increased the number of nested reflectors possible. XMM-Newton uses such optics and consists of 58 nested reflectors compared to 4 for Chandra. Aside from the manufacturing cost of the reflectors themselves, the mass of the telescope is a large factor that determines the overall cost of the mission, mainly due to the requirements of the launch vehicle. The proposed innovation seeks to improve upon the current state of the art by replacing much of the NiCo with a stiff, lightweight ceramic material. A thermal spray process will be developed to allow for the deposition of porosity graded alumina onto the rear surface of the reflector. Several diagnostic techniques will be used to adjust the inflight particle state as well as the resulting residual stress of the coating as to not adversely affect the figure accuracy of the optic. The gradation of the alumina layer will allow for CTE matching with the electroformed shell as well as optimization of the ceramic stiffness. By reducing the NiCo layer from 1mm to less than 100um and adding a 200um alumina layer as the support structure the overall mass of the telescope can be greatly reduced and thus reduce the overall cost of the mission. Additionally the overall thinner optic would allow a greater packing density and increase the capabilities of such X-ray telescopes.

Primary U.S. Work Locations and Key Partners





Light Weight, Scalable Manufacturing of Telescope Optics

Table of Contents

Light Weight, Scalable Manufacturing of Telescope Optics, Phase I

Completed Technology Project (2013 - 2013)

Organizations Performing Work	Role	Type	Location
ReliaCoat Technologies, LLC	Lead Organization	Industry	East Setauket, New York
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	New York

Project Transitions

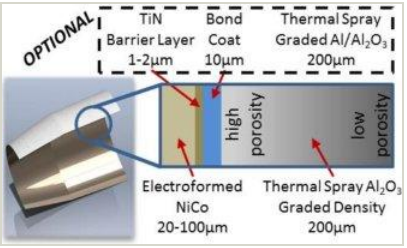
May 2013: Project Start

November 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140448)*

Images



Project Image
Light Weight, Scalable Manufacturing of Telescope Optics *(https://techport.nasa.gov/image/131673)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
ReliaCoat Technologies, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Christopher J Jensen

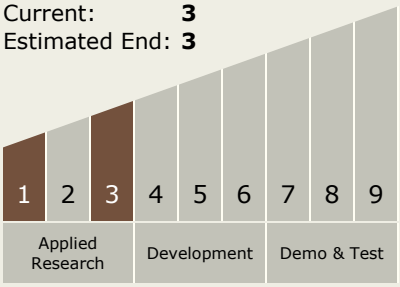
Co-Investigator:
Christopher D Jensen

Light Weight, Scalable Manufacturing of Telescope Optics, Phase I

Completed Technology Project (2013 - 2013)

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System